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Columbia University
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SCHOOL OF ARCHITECTURE

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ITS RESOURCES AND METHODS

Reprinted from the COLUMBIA UNIVERSITY QUARTERLY, June, 1900

THE INSTRUCTION IN PRACTICE

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THE SCHOOL OF ARCHITECTURE: ITS RESOURCES AND METHODS

WHILE in England and in France the schools of architecture are generally attached to schools of painting and sculpture, those in this country have generally been grafts upon schools of science. The necessary instruction in physics and chemistry, mathematics, mechanics and engineering being already provided, all that seemed necessary to equip a school of architecture was instruction in drawing and design. These branches were, in the school established at Cornell University in 1871 and that of the University of Illinois, founded in 1873, for many years somewhat under the sway of English traditions. But the little class which Mr. Richard Hunt started in the Studio Building in Tenth Street, when he returned from Paris in 1857, eager to hand on to others the lamps he had there lighted, he of course conducted after the manner of a Paris *atelier*. This class was the immediate parent of the school at the Institute of Technology, founded in 1865, and hence of our own, which dates from 1881. Both there and here, and wherever else schools of architecture have since arisen, the methods of the Paris school have been more or less precisely followed, and the actual instruction has been chiefly in the hands of its pupils or its pupils' pupils. To this instruction in science and in art the different schools have added the teaching of history, the modern languages, æsthetics, the auxiliary arts and the writing of English, in various proportions, with more or less of practical construction and office work, in anticipation of experience in actual affairs.*

* Papers relating to this School have been printed from time to time as follows:

In the *School of Mines Quarterly*:—"The Instruction in Architecture in the School of Mines," Nov., 1888; "The Study of Architectural History," Nov., 1895; "The Study of Architectural Drawing," April and

But though the American schools of architecture are so far all very much alike, they differ considerably in the degree of importance they assign to these different subjects, in their methods of instruction, and perhaps still more in their equipment and in the more or less favorable circumstances of their environment.

The surroundings of our own school are obviously most fortunate. The most conspicuous feature among them is the city itself—a great museum of architecture, with full-sized models of almost every species of building, many of them of great excellence, and a very large number of them carefully based upon the best examples, in their details if not in their entirety. Those which are still in process of construction offer unprecedented opportunities for the study of the best modern practice. The Metropolitan Museum, just across the park, contains, besides its collections of painting and sculpture, innumerable examples of the applied and decorative arts auxiliary to architecture, while the Willard collection of architectural casts and models is, if not the largest, probably the best selected and the best arranged series in the world. The shops are full of the best modern paintings and of every species of artistic manufacture, displayed in their windows so that he who walks by may study them, and the annual exhibitions of the Architectural League illustrate the present condition of architectural design and the best practice in architectural drawing. Even within our own doors we have an invaluable equipment of drawings, photographs, books and prints that count by thousands, lantern-slides by the hundred, plaster-casts that cannot be duplicated, and a

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July, 1896; "Professional Draughtsmen as Special Students," July, 1897; "The School of Architecture in its New Quarters," April, 1898.

In *Architecture and Building*, "The New Course in Architectural Engineering," August, 1897; and in the *American Architect*, "Perspective and Descriptive Geometry," April, 1898, and "An Address before the Architectural League," August, 1898.

Most of these papers have been printed for distribution and may be obtained at the School.

growing collection of building materials and appliances. Indeed, the buildings of the University themselves are not without their lessons.

It is something, too, to spend four years in a town where so many good architects are doing so much good work. Personally, they are hardly in evidence. But their near presence is not forgotten, and it gives dignity and importance to our undertakings. It is seen to be no light matter to be in training for such a career as theirs. Moreover, they are always glad to have our graduates in their service, and not only is this of ultimate advantage to our men, but the expectation of it is, meanwhile, a powerful incentive to self-improvement.

It is true that at present we are able but scantily to profit by this wealth of material lying just at our doors. Our time and our students' time is mainly taken up with the A B C of the art. We seldom, in point of fact, have to do with anything outside of our own walls. Given a few thousand dollars' worth of books, drawings and photographs, and what we do we could do just about as well any where else as at 116th Street. But the possibilities are boundless; and when the schools in less favored localities have succeeded in doing what we are now doing, we may hope to leave this work to them and advance to the enjoyment of our priceless inheritance. What we are now doing is no measure of what we are ready to undertake.

But already we are in the full fruition of one of our most valuable possessions. The Architectural Library, established by the munificence of Mr. and Mrs. S. P. Avery, in memory of their son, a young architect of most excellent promise, is one of the largest and best collections of such books anywhere to be found. Moreover, it is administered with a liberality and a consideration for the needs of students which more than double its value. In one respect it is believed to be unique among public libraries, in that it has attached to it a well equipped draught-

ing room, where students and visitors can work under conditions unprecedentedly favorable. Of this we and our students already make the utmost use, and find it of the greatest service.

What brings our men so much to the Avery Library is the unusual prominence we give to historical studies, and one reason why we give to these studies more time and attention than they receive in some other schools of architecture is that our men may make the acquaintance of books and acquire the habit of using them. But the chief reason is that it enables our students to enlarge their professional resources, as if by travel, and thus to escape the limitation of thought which so often shows itself in schools by an academic monotony and in the practice of the profession by poverty of ideas and a premature exhaustion of the imagination. To this end we not only give from three to five hours a week each year to stated lectures upon architectural history and ornament, taking up ancient history in the first year and mediæval and modern in the second and third, but we go so far as to interrupt the studies in design, which are our main concern, and for six or eight weeks in the spring substitute for them exercises in historical research, ransacking the library and the collections of prints and photographs, and making sketches and tracings, on a carefully prepared system, of plans, sections, elevations and details. By thus turning to the works of the masters, we hope to avoid the growth of a school style and that habit of copying one's own work which is a vice natural to schools of art. Wholesome traditions we hope to establish; but the process of breeding in and in, so to speak, by which each generation of students imitates the successes of its immediate predecessors, is a sure road to barrenness of invention and to the caprice and eccentricity which come in as the inevitable consequence of it. We find that the time thus taken from the practice of design is twice blessed. The work in design is itself promoted by the interruption.

A feature which distinguishes our methods from those of most institutions of learning, and is perhaps not elsewhere to be found, still further brings the Avery Library into the field of our activities. We have managed to concentrate almost all our stated instruction into the first three years of the course, leaving the fourth year almost entirely free from recitations and lectures. As there are, accordingly, few lessons to study or notes to write up, the evenings of the whole fourth year are left free for reading and writing, and the Avery Library is largely put in requisition for this work. Every student in the summer preceding his fourth year prepares a paper of five or six thousand words, by way of practice for what is to be a chief occupation of the winter. Then the eight months of winter evenings that follow are devoted to what we call our Advanced Architectural History, similar papers, longer or shorter, being prepared every month or six weeks until spring. These papers, beginning with the summer essays, are read before the class on Friday mornings throughout the year. They have proved to be, in general, entertaining and instructive; they open up fields for investigation that the stated courses of study necessarily leave on one side; and they afford excellent practice in collecting and arranging material and in putting the results into shape. For this literary work the weekly essays written during the two previous years, including those which accompany the work of historical research and the more elementary themes written during the first year, afford some preparation.

The whole of the daytime in the fourth year is thus set free for the practice of drawing and design, exercises which are so much interrupted in the previous years by other studies that hardly more than the bare elements can be mastered. But in the fourth year the whole day is given to work in the draughting-room, time which is of the greater value for being consecutive and free from interruption. Large and small problems alternate through the year; and at the end, in April and May, works of

considerable pretension are undertaken under the name of graduating theses. These are hung around the walls of the draughting-room through the following year, to be replaced in turn by the work of their successors. The variety of character exhibited in these drawings, the ultimate fruit of our endeavors, and the marked individuality of treatment which they not infrequently present, testify to the value of the historical studies upon which they are based. They often seem more like work from so many different offices than like the work of a single school, controlled and directed by the same personal influences.

Another feature which distinguishes our work from that of some of our neighbors is the special advantages that we offer to professional draughtsmen. But these have already been sufficiently set forth in another place.

In respect to the methods by which these ends are reached, we find ourselves, as we learn the lessons of our own experience, departing more and more in matters of detail from Paris traditions. This is what was to be expected—and, indeed, hoped for. The *École des Beaux-Arts* is indeed, our *fons et origo*, but the conditions are too different, there and here, for close imitation to be safe. In Paris the *nouveau* is thrown into the deep waters of the *atelier* to flounder as he may, with a dozen *anciens*, of greater or less degree of maturity, to teach him his strokes and to see that he does not hopelessly go under. By hook or by crook, he picks up a knowledge of what he needs to know, finding always somebody at hand who, in requital for such services as he can render, will answer all his questions as they arise. It is an admirable system, prompt and efficient, but it requires *anciens* to work it; and *anciens*—that is to say, skillful and experienced men—would not stay in school after they had become experienced, if they had not the *Grand Prix de Rome* to look forward to. But they would not even go to Rome, and there spend three or four of

the best years of their lives in further academic study, if they had not the promise of government patronage to look forward to on their return home. It is upon this government patronage that the whole Paris system rests. The *camaraderie* and mutual help that make the system of *atelier* instruction so delightfully efficient would be of little value without it, for the *anciens* would not stay long enough to get really old.

The Paris schools possess the further advantage that the best architects in France find leisure to take an active part in them, supplementing and completing the work of the *anciens*. This advantage cannot be had in this country. In a school like our own, all the instruction has to be given by two or three men—two or three teachers to eighty or a hundred students. The work must needs be done in classes, not man by man, and we must make up for this disadvantage by improving and perfecting our methods. For the purposes of class instruction the work has to be analyzed and systematized into a series of carefully graded exercises. In this we have made good progress and have already achieved excellent results. The more elementary work is done quite as well as it is done in Paris, and more promptly and surely. Even the more advanced work seems to be quite up to the Paris standard for work of the same grade, and considerably more uniform in excellence, as would naturally happen from the greater uniformity of the teaching. All this leads us to hope that, if the time ever comes when we can keep our men as long as the *ateliers* keep theirs,—or, which comes to the same thing, can begin our work with students already advanced,—it may equal also the more advanced work of the *École*. Meanwhile, the best thing our men can do, if they want to carry their schooling further, is to go to Paris; and that they do in large numbers, making for themselves there an excellent name.

But it is in the internal administration of the school that there is the greatest departure from the Paris tradi-

tions. For the last hundred years, at least,—that is to say, ever since Napoleon proclaimed the *carrière ouverte aux talents*,—the system of competition for place has pervaded French institutions. The *École des Beaux-Arts* is an admirable and efficient organism of tests and examinations, mentions, medals and all sorts of honors, calculated to stimulate its students to their utmost endeavor and to add the spur of emulation and personal distinction. For all this machinery the promise of government support to the man who wins in the race furnishes the motive power. The whole is so complete in every part, so smooth and effective in its workings, and the result so sure, that one is disposed to think that like effects can be produced only by like causes, and that the best anyone could do would be to profit by so brilliant an example and follow it point by point. But in this country such a course is impossible. The mainspring of government patronage is wanting; and, though one might fancy that, even so, the forces of rivalry and personal ambition would suffice to accomplish the same ends, it is doubtful whether even in Paris, where all the habits and traditions of society are in harmony with the system, the medals and mentions, even the *Prix de Rome* itself, would prove to have any lasting validity without it. It is not the piston or the driving-wheel that moves the train, not even the boiler behind them, but the coal hidden under the boiler. In this country, where the whole system of examinations and competitions and prizes is unfamiliar, uncongenial to our habits and in general distasteful, there would seem to be little chance of making it effectual, even if what experience of it we have had did not discourage the expectation. And, in fact, the present tendency seems to be the other way. The prizes for scholarship established by a previous generation have not worked as was expected; and the establishment of new prizes for school work is, in this locality at least, officially discouraged. The traditions and habits, as well as the underlying forces, that render this system so successful

abroad seem to be lacking here. Even in a *jardin d'acclimatation* it is not the exotics but the native varieties, sprung from the soil, that best flourish and grow. Different peoples have different ways, and in this country the ultimate energies that make the world go round reside not in the government but in private persons, and we rely upon personal interest to carry to an end what personal initiative has begun.

Moreover, the conditions which in Paris reduce to a minimum the disadvantages of the system are also lacking in this country and are not likely to be supplied. Gossip and scandal, charges of partisanship and undue influence among the judges, and of intrigue and bad faith among the competitors are, indeed, not unknown even in Paris. But these things need not be taken too seriously, for they are inseparable from the system. But the more offensive and obnoxious elements of personal jealousy and hostility are there largely eliminated by the fact that the rivalry and emulation in the School of Fine Arts is not between persons, so much as between different *ateliers*. This raises the whole tone. For private quarrel is substituted, as it were, a state of public war, with the dignity and responsibility and the freedom from personal feeling that common sacrifices in a common cause naturally involve. Between members of the same class in the same school there is no such protection from the baser passions.

Besides, after all, we must believe that even in France —in France, indeed, more than anywhere—the real motive power in all their splendid achievements is to be found, not in any external conditions or inducements whatever, neither in the hope of government employment nor in academic honors. The somewhat second-rate men who throng the government schools, in the hope of escaping military service, may very likely need these pricks and goads to keep them up to their work. But with the best of the Frenchmen, as with the large and brilliant company of American students who join their ranks, the motive

forces, as we must believe, are to be found within. It is the importance and interest of the subject and their own enthusiasm for it that animate the men at the top of the school and crown its work. So in England. The English may be a nation of shop-keepers, as Sam Adams called them, and the extraordinary prevalence of money prizes for every species of scholastic endeavor may seem to give evidence of a most mercenary spirit. But this is a mere national habit, a curious tradition; and one must believe that English culture and scholarship would be the same, if all the exhibitions and foundations were abolished, the English people being what they are. It is not these that achieve the result, but intellectual character and elevation of mind.

For our own part, at any rate, these are the lofty foundations on which we prefer to build; and so far we have found little occasion for serious misgivings and little inducement to change our policy. So long as the standard of performance seems to be steadily advancing, as it does year by year, we feel that there is no telling what degree of excellence may not be attained under these wholesome and elevating conditions in a stimulating and generous atmosphere. These are the influences that an architect must rely upon to carry him happily through the vexations and labors of a most exacting profession. These must be his permanent motives of conduct; and the sooner he is habituated to them the better. If his love and devotion are not of this fine quality, he had better do something else. If they are sufficient for these encounters, they will certainly suffice for the work of a school. Indeed, as William Morris has said, "The true incentive to useful and happy labor is and must be pleasure in the work itself;" and, whatever may be said against architecture as a practical calling and mode of earning one's living, as a study it is, for those qualified to pursue it at all, the most delightful in the world.

It is true that we thus lose the excitements and the pictur-

esqueness of the arena, that the spectacle is less entertaining to lookers-on, that life is somewhat less amusing to ourselves, and that sometimes we have men—occasionally we have a whole class—who lapse into sloth and seem to need some artificial stimulant. But in many cases they presently recover their tone, and then we are rewarded for our faith in the *vis medicatrix naturæ*. Even where this fails—and we have to admit that our system is not without its victims—we are comforted by two considerations. The first is, that prizes and personal distinctions benefit at best only the men at the head of the class, and are likely to discourage those who from lack of early training, from immaturity or from some peculiarity of temper are beyond their reach. In any body of young men between the ages of eighteen and twenty-two there are many such; and hardly a year passes in which the slow development and final success of an unpromising student do not show us what injustice may be done by rating men, prematurely, according to their actual achievements. It is not the physical advantages of a steady hand, or even of a quick eye, that tell in the long run, but the mental qualities of good sense and good taste and a creative imagination. These are qualities that may presently develop themselves in a man whose fingers are all thumbs. It does not do to discourage such men at the start, by gazetting them at the foot of the list.

All this does not mean, however, that the difference between good and bad work is not recognized, or that the achievements of the dull or lazy are confounded with those of the more capable or more diligent. If the men are not weighed, their work is. The designs are not, indeed, marked as first or second in total merit; but they are analyzed and criticised before the class, so as to expose their strong points and their weak points, in planning, composition, detail and rendering. This seems more intelligent, as well as more just, than to say that one scheme is on the whole the best, in spite of its faults, and another

unworthy of mention, in spite of the skill and pains bestowed upon it. It is certainly more discriminating, more consonant with the purposes of a school and more helpful to the scholars. In these judgments we often avail ourselves of the friendly services which the architects in the town are always ready to offer.

Nor does it mean that our men are without the spur of personal ambition and of the emulation which is kindled by admiration of their betters. But an eager desire to do as well as the best is one thing; wanting to win a momentary fame by beating them on the mark-list is quite another. Nor are they without the stimulus and encouragement that come from the hearty recognition and appreciation of success. But they escape the depressing influence of formal comparisons and official depreciation. As one of them was heard to say to a visitor, some years ago, "The best thing about this school is that one man is as good as another." Moreover, they escape also the duplicity of purpose which tends so greatly to impair the sincerity of work done with two ends in view. As another of our men, and one of the best of them, once said, in speaking of the graduating theses, "The most satisfactory thing about them was that we knew they weren't going to be judged. We felt perfectly free to do what we really thought was best, without having to consider what the jury would probably think."

The other reason for keeping on as long as we can in our present way is that we are thus exempted from the personal jealousies and antagonisms which, as may be seen even in the army and navy, a system of rank and promotion can hardly escape. As it is, our society seems eminently free from these disturbing influences, and we are naturally slow to accept a policy that might bring a cloud or storm into the serenity of our skies.

In all this we are glad to feel that we have the loyal and cordial support of our own graduates, and that those among them who are most earnest in urging us to keep to our own ways, and not to budge, are those who have had

most experience of the *École des Beaux-Arts* and are most grateful for the service it has done them.

But these considerations apply only while the men are in school. When once they are out and on their own feet, it is a wholesome exercise, during the next six or eight years, for them to test their strength and prowess against each other. For this the travelling fellowships, endowed by Mr. McKim and by Mr. Perkins, and established by the Trustees themselves in recognition of Mr. Schermerhorn's liberality, afford an excellent field. We refused these endowments for the men still under pupilage, saying that we did not believe in prizes for school work and that our men had no time while in school to spend upon prize work. But for our graduates they are an unmixed good. The men who win obtain a great benefit, and the men who lose have an opportunity for graduate study, on the lines of their school work, which they highly prize.

This result of these endowments is perhaps quite as beneficial as the other. They are open to all graduates of the school under thirty years of age; and every year ten or fifteen men, sometimes more, occupy the leisure of two or three months in the study and execution of the required drawings. Among them are always some who are pursuing their studies in the *École des Beaux-Arts;* and it is gratifying to find that neither in the arrangement of the plans, in the composition of the elevations, nor in the execution of the drawings, do these designs show any obvious superiority over those made in this country. This encourages us to believe that, if we were able to maintain a graduate course or—which comes to the same thing, as has been said—to advance by a year or two our requirements for admission, so as to make the most of our environment, we should be able to do work of a more advanced character as efficiently as we now do what we now undertake.

The work done by the holders of these travelling fellowships while abroad is adjusted rather to further each

man's personal needs than to achieve notable results. When it comes home, it exhibits every variety of performance, from notes and sketches of travel to measured drawings, or *projets* made in the *École des Beaux-Arts* or some of its preparatory schools. This freedom is characteristic of our policy, even within the lines of our school work. While the tasks we prescribe, whether in drawing or in design, in historical research or in the writing of essays, are defined by strict limitations, within that range we encourage the greatest possible variety. In this way we not only foster independence and individuality, but manage to keep men of very different calibre at work in the same field, without over-taxing the weak or holding back the swift-footed.

The year always ends with the exhibition of the total work of the school, and the work done abroad by the holders of the fellowships serves as a most attractive side-show. We put up all the work, that of the worst performers as well as that of the best. This we do, not only because it is quite in harmony with our general policy of avoiding personal distinctions, but because we are really quite as proud of the poor work as of the good. Any class may be trusted to have a few exceptionally bright men who will do us and themselves great credit. But this credit belongs mainly to them. The most that we can pretend is that the honors are even. The successes achieved at the other end of the class, however, we feel to be mainly our own; and when it happens, as it sometimes does, that it is not easy at first glance to tell the good work from the poor—when visitors ask us, as they sometimes do, what sort of work the incapables do, and we answer that it is before them, then we feel very much gratified. It bears testimony to the efficiency of our discipline. But this happens only in the earlier years, the years of training. Before these are through with, the best men are well ahead.

These are the favorable conditions under which our work is done, and these are the ideas and ideals by which

it is inspired. We are enrolled among the Schools of Applied Science; but this is rather a tradition from an earlier age than a just expression of present conditions; for, though we avail ourselves of their neighborly offices to gain for our students in architectural engineering advantages not elsewhere to be had we are almost as independent of them as is the College. We are, indeed, in spirit really more akin to the College than to them, in spite of our claim to be a professional school and not an undergraduate school, and of our refusal to look upon our students in the light of sophomores and freshmen. Architecture is, in its many-sidedness and in the generosity of its aims, much of the nature of a liberal study, and we are disposed, so far as may be, to have it altogether such. It is this attitude and temper on our part which most makes our men value the time they spend with us, and it is this, perhaps, which most differentiates this school from those in which, as in the *École des Beaux-Arts*, men are regarded chiefly as designers, and resembles it to those which regard their students as, first of all, men.

The annual exhibition opens with an annual *Banquet*, a modest repast to which the graduates of the School flock in large numbers, and at which the graduating class are always present as guests, so that they may take their place in the company of their predecessors. These gatherings notably accentuate the personal and friendly relations, the establishment and furtherance of which is one of the best results that such schools can attain.

WILLIAM R. WARE

THE COURSE IN ARCHITECTURAL PRACTICE.

It is an open question how prominent a part the practical side of the profession should occupy in the curriculum of a professional school. That it is easier to acquire theoretical knowledge within the walls of a schoolroom and practical knowledge outside, is not a sufficient reason for neglecting practice altogether. Almost all schools recognize this and include more or less of practice in their courses. Thus engineering schools have summer classes in surveying, mining and shop work; law schools have their mock trials and medical schools their clinics and laboratories. In schools of Architecture, also, though it is their first duty to teach what cannot be learned elsewhere, giving themselves mainly to History and Design and to Scientific Construction and leaving Practical Construction to be learned in offices, it is well not to neglect office work entirely. The simultaneous study of Architectural Practice gives to the work in Architectural Engineering much seasonable illustration. It is well also for a student to make a survey of the whole field of office work before taking it up in detail, and such a survey is more practicable in a school than in an office. It is of the nature of school work. Some schools include in such instruction the arts of the carpenter, mason and plumber, but shop-work takes more time than we can ourselves spare from more profitable things, and our own course in Architectural practice is confined to lectures, with illustrative exercises. Our students find that this suffices to save them six months' time when they come to study these things in the office themselves.

The practice of Architecture comprises the preparation of the working drawings and the superintendence of the various operations and processes by which these are carried into execution. The preparation of the drawings and specifications demands familiarity with the prevailing forms of construction and with the nomenclature and character of the multitudinous objects of carpentry, masonry, plumbing, painting, glazing, hardware, etc. The superintendence of a building in process of erection requires, furthermore, acquaintance with the names and properties of all sorts of building materials and apparatus, and with the methods for testing

them: a kind of knowledge which, while covering the same ground with that of the specifications, is quite distinct in character. We have accordingly two distinct courses of lectures: one on Specifications and the other on Building Materials and Superintendence.

It is the object of the course in Specifications to familiarize the students with the ordinary forms of contracts and specifications, with various details of construction, and with general office management. A model specification has been prepared which embraces all of the particulars likely to occur in different kinds of buildings. It has been compiled from the best attainable specifications of private dwellings, churches, hospitals, warehouses, public buildings, etc., the architects of which have kindly put their specifications at our disposal for the purpose. It thus embodies the experience of many years in active professional work. This specification is read and explained to the class and the details of construction which it calls for are illustrated by diagrams and by copies of working drawings. The diagrams, like the specification, cover the whole field of building operations. They are nearly two hundred in number, and illustrate not merely details of construction, but various building operations such as shoring, underpinning and pile driving. This specification has been printed and it is distributed to the class, a page or two at a time, before each lecture. The students are required to copy it in a special book, to take notes of the explanations and to make sketches of the diagrams, the alternate pages of the Specification Book being left blank for future additions. The more important diagrams have been reduced to convenient size and are also printed and distributed. A page of the model specification and reproductions of some of the diagrams are given at the end of this paper.

The lectures on Specifications treat, first, of the general law of contracts and the various forms of contracts in use; the different ways of preparing plans and specifications for estimates; and the instructions to bidders, the rules to be observed in writing specifications and the proper form for the general clauses; secondly, of the specific clauses illustrating the various details of construction. These clauses are grouped under the heads of Carpentry, Masonry,

Structural Steel and Iron Work and the Plumbing and Drainage of Buildings.

I. Under the head of Carpentry are explained the ordinary methods of framing and the advantages and disadvantages of each, the preparation of framing plans and elevations and the details of all of the joints and connections. These lectures are further illustrated by diagrams, working drawings and models. A model of a regular mortise and tenon frame, one-eighth full size, but complete to such small details as hard wood pins, joints and bridle irons, is built up before the class so that they see not merely the completed frame, but the process of putting it together. Full-size models are shown of all the principal joints and connections. The framing of roofs is then taken up in the same way. After this the minor details of carpentry, sheathing, flooring, outside and inside finish, and the construction of doors, windows and frames are specified and explained.

The subject of slow burning or mill construction follows and is illustrated by lantern slides showing factory buildings at different stages in the development of the system, and also by diagrams, working drawings and models. The models are all one-eighth full size and show the general lay-out of factories and mills and the details of their construction. One of them was made under the direction of the president of the Boston Manufacturers Mutual Fire Insurance Company and illustrates the methods recommended by that company. The application of the principles of slow burning construction to domestic architecture is also explained. The last lectures given under the head of Carpentry are devoted to the various kinds of roofing employed, shingles, slates, tiles, tin, etc.

In order to make the present methods of building more fully understood, the history of each operation is gone over whenever possible. The mediæval methods of framing, for instance, are first explained and their influence upon the earlier colonial frames is traced. Then the evolution of mortise and tenon framing is shown and finally of balloon framing. A comparison between the methods in vogue in different countries and in different sections of this country is made whenever practicable.

II. Under the head of Masonry are included, first, the preliminary operations of surveying, excavating and draining, sheet

piling, shoring and underpinning; secondly, foundations: stone, brick and concrete footings, inverted arches, I beam grillage, piles and pneumatic caissons, in illustration of which there has been made a large collection of plans of the foundations of notable buildings, such as the St. Paul, Havemeyer, New York Life, American Tract Society and others; thirdly, the superstructure: rubble stone, brick and cut stone walls and piers, chimneys, etc. Cut stone masonry is illustrated by specimens of stone showing all of the facings in use and also the implements for making them. Finally, plastering, fireproofing and the use of terra cotta complete the list of building operations taken up under this head.

III. The specification for Structural Iron and Steel Work includes the entire subject of modern steel skeleton construction. This subject is so modern a one that most of the information in regard to it is to be found only in the technical journals and the methods are so continually changing that since this course was first given it has already had to be twice rewritten in order to keep up with the times.

This specification begins with the preliminary mill operations of punching, drilling, reaming, assembling, bolting and riveting. Then come the details of construction, such as the various forms of bases, cast iron and built-up columns, column connections, beams, girders and lintels, framing, connections and wind bracing. The advantages and disadvantages of each form of column and connection are explained, and full size sections of built-up columns and models of connections are shown.

IV. The final lectures are devoted to the Plumbing and Drainage of Buildings and to the different methods of disposing of household refuse. The requirements of the New York City Board of Health are taken as the basis of this specification and it is illustrated by a model showing the plumbing of an ordinary city house. Next winter additional lectures will be given on the ventilation of various kinds of buildings, private houses, schools, theatres, hospitals and public buildings, and also upon heating by the hot air, hot water and steam systems.

Besides the lectures on Specifications, every other Thursday throughout both terms of the third year is occupied in working

out a practical problem in construction and making the ordinary detail drawings for wood, stone, brick and iron work and the plans and elevations of a system of plumbing. These drawings are made just as they would be in practice, and the experience the students gain from them is such that upon entering an office they are able to make without much difficulty any ordinary detail. They are, therefore, able to begin as draughtsmen and not as students or office boys.

This course in Specifications sufficed to show how the various materials used in building are employed. It remained to organize a course upon the materials themselves. To be sure, lectures in hygiene, sanitary engineering, chemistry, physics, botany, and geology, had in earlier years supplied some of this information but it was not taken up from an architect's standpoint. For the last three years accordingly these lectures have been replaced by a course in Building Materials, and those on hygiene and sanitary engineering by the lectures on plumbing, heating and ventilating already mentioned.

The lectures in Building Materials treat of the history, geology, botany, chemistry, physics, methods of manufacture, tests and uses of the materials mentioned in the specification, and they are illustrated by samples of lime, iron, clay, etc., in various stages of manufacture and also by models and diagrams of furnaces, kilns, etc.

These lectures like those in Specifications, are now given twice a week during the third year. They also are grouped under the head of Carpentry, Masonry, and Iron and Steel Work, and are so arranged that they accompany those in Specifications, subject by subject. When for example brickwork is taken up in the course in Specifications, the manufacture of bricks and the tests to be applied to them are explained in the lectures on Building Materials.

I. Under the head of Carpentry the various kinds of woods are treated; their botanical character, growth, preservation, decay, method of cutting and seasoning, the classification, grading and testing of lumber, and the manner of specifying the different grades. The structure of wood, the phenomena of shrinkage, the recognized defects in different kinds of timber and their various economic uses are also taken up. Finally a "key" is explained

by which it is possible to identify with exactness the various species of wood. This key, which is one of the publications of the United States Department of Agriculture, is based upon the invariable differences in the structure of the different woods. The usual botanical distinctions are useless for architects and engineers as they seldom see anything but the dressed lumber, stripped of its leaves, blossoms and bark. They need therefore to learn to recognize lumber from its structure as shown in the different sections. To illustrate this, lantern slides of the cross sections highly magnified are thrown upon a screen and a set of Hough's Wood Sections of the Native American Woods, and samples brought from the lumber yards, are shown to the class. At the end of the lectures each student is provided with a sample of every kind of wood shown and is required to identify it, just as if it were a mineralogical specimen. This has now been tried long enough to show that the results are very satisfactory.

II. Under the head of Masonry come the soils, their bearing power, methods of determining it, etc.; then the building sands and limes, cements, mortars and concrete. In addition to the physics, chemistry and methods of manufacture, tests of the quality of limes and cements are performed before the class. The tests of cement are made in the laboratory of the Department of Mechanical Engineering. They are those recommended by the American Society of Civil Engineers and include tests for tensile strength, time of setting, hardness, soundness and fineness of grinding. After this follow the various kinds of building stones, bricks and terra cotta, and the soft-mud and stiff-mud methods of manufacturing bricks, and the tests to be applied, are also explained. Plaster and asphaltum complete the list of building materials mentioned in the masonry specification.

III. The materials treated under the head of Steel and Iron Work are cast iron, wrought iron and steel. The different ores used for their production, and the operation of a blast furnace are explained Especial attention is given to the tests of the materials, the different methods of manufacture and the influence of these methods upon the character and quality of the product. The lectures furthermore include the operation of making castings, the contingencies which may arise in their manufacture and the tests to which all

castings should be subjected; also the operation of rolling out the various wrought-iron and steel sections.

Saturday mornings are from time to time employed in the inspection of buildings in process of erection and of various shops, such as rolling mills, brickyards, foundries, etc.

A museum of building materials, appliances and models has already grown to considerable size. It contains a large number of models of wooden and steel construction, samples of bricks, terra cotta, stones, hardware and of nearly every other material mentioned in the specification. The specimens of terra cotta arches and fireproofing formed part of an exhibit at the Chicago World's Fair and were presented to the school by the exhibitors. The collection of native American woods is especially complete, including all the common species used in building and many of the rarer ones. A part of this equipment has been obtained by purchase, but the greater portion has been contributed by the generosity of manufacturers and dealers in this city.

The course in Architectural Practice is complementary to the course in Architectural Engineering and the two are so arranged that the same subjects are treated at the same time. Thus lectures in Architectural Engineering on the strength of rivets and the supporting power of columns, occur at the same time as the lectures in Architectural Practice on punching and drilling, the different methods of riveting and the various forms of built up columns. The practical work in both courses is also complementary; one Thursday for example, the problem will be the calculation for a riveted girder, and on the following Thursday the problem will be the making of a working drawing for the same girder. All this practical work is moreover complementary to the Third Year problems in design. If, for example, the problem in design is a country house, a city house or a library, the practical problems are, a framing plan and elevation of the country house, $\frac{1}{4}$ inch scale working drawings of the city house or the calculations for some of the arches, trusses or girders in the library.

These courses in Practice and Engineering cover the entire field of Architectural construction and may be taken independently of the other work in the School. Although they are intended primarily for students of architecture, parts of them at least might be taken with advantage by draughtsmen and superintendents in architects' offices, by builders, or indeed by anyone interested in building. Those who are qualified to pursue them may enter the School as special students and select for study whatever subjects they care to. An article on "Professional Draughtsmen as Special Students in the School of Architecture," published originally in the QUARTERLY for July, 1897, has been reprinted for the School of Architecture, and copies of it may be obtained upon application to the Bursar.

CHARLES P. WARREN.

Specimen page of Model Specification.

Expressions in italics may be changed. Expressions in parentheses ( ) may be omitted and those in brackets [ ] substituted instead, preference always being given to the first.
Numbers on margin refer to construction plates.
All sizes and dimensions are approximate and absolute.
*, †, ‡ are explained at bottom of page.

MASON 1.

NOTE. All of the general conditions prefacing this specification, except (§) apply to the execution of all works described under this heading.

PLATFORM AND BRIDGE PLATES 1 AND 2 M

Before any work on the present site is begun, the Contractor must erect *along the street front* a *yellow pine* platform and bridge, *ten* feet wide and *fourteen* feet high.

PLATFORM.

1
2

The uprights are to be 12″ x 12″, set *eight* feet on centres; the plates 12″ x 14″, and the sills (12″ x 12″) [6″ x 12″ securely bolted to both sides of uprights]; all are to be well bolted together and braced at all angles by 2″ x 6″ planks securely spiked.

The floor of the platform is to be made of 4″ x 12″ planks laid flatwise and well spiked to 10″ x 12″ cross timbers set *four* feet apart and well spiked to the plates.

BRIDGE.

2
1

The bridge * (under the platform) is to be made of 3″ x 12″ planks laid flatwise and well spiked to (6″ x 12″ sills) [to 6″ x 8″ cross timbers set *four* feet apart and spiked to sills] † (and provided with necessary supports properly braced); construct suitable steps at each end, and a strong handrail along the outside of steps and bridge, all to be well braced, bolted and fastened.

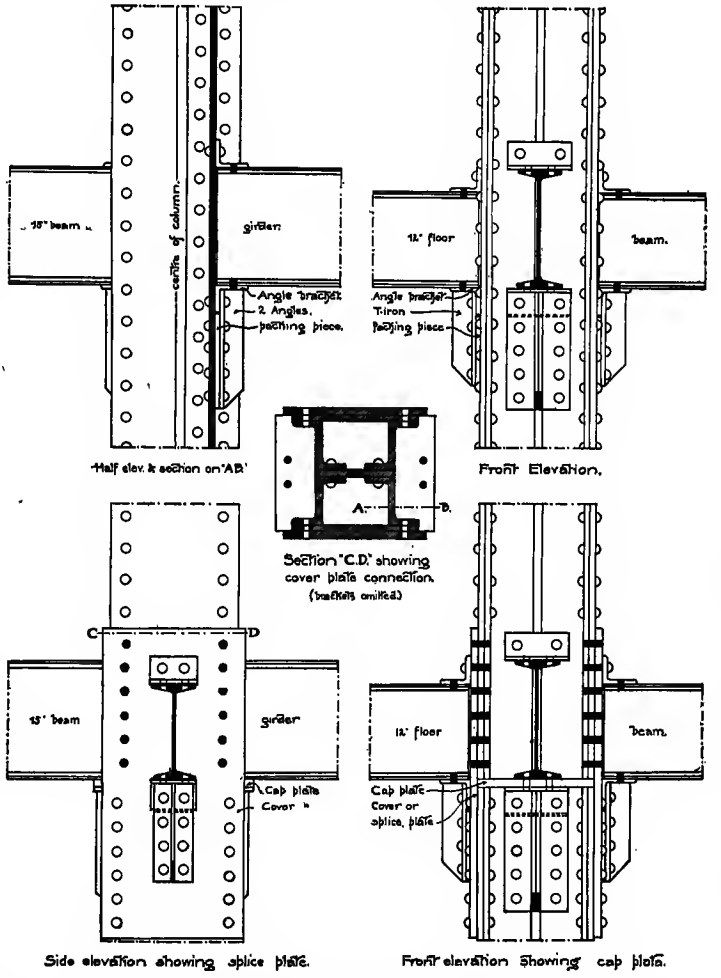
Over the bridge provide and put up a roof of 2″ x 9″ planks laid double with a 12″ pitch, and well nailed to necessary supports * (spiked to uprights) † (properly braced.)

* Insert when bridge is built under platform as shown in Plates 1 and 2.
† " " " " " without a platform.

PLATE 15,I.

Z-BAR COLUMN CONNECTIONS.

For specification see pages 3 and 16 I.



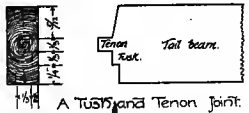
This column is two stories in height making the column joint at every other floor level. Plate 3,I. shows details of base connection.

Scale 1½"=1'-0".

PLATE 14 C.

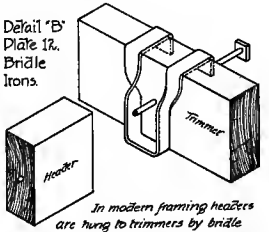
DETAILS OF FRAMING

Specified on pages 7 and 8 of the Carpenters Specification.



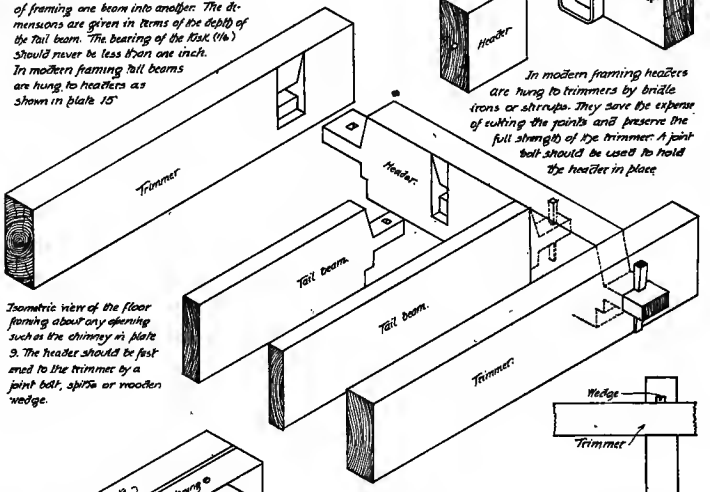
A Tusk and Tenon Joint.

This is the most common and the best way of framing one beam into another. The dimensions are given in terms of the depth of the Tail beam. The bearing of the Fast. (1/8) should never be less than one inch. In modern framing Tail beams are hung to headers as shown in plate 15.

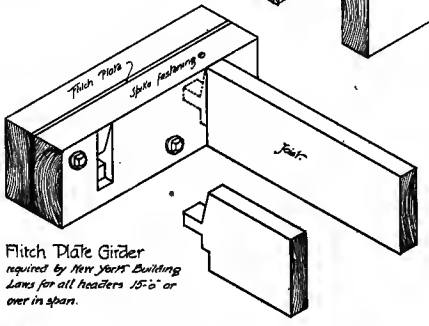


Detail "B" Plate 12. Bridle Irons.

In modern framing headers are hung to trimmers by bridle irons or stirrups. They save the expense of cutting the joints and preserve the full strength of the trimmer. A joint bolt should be used to hold the header in place.

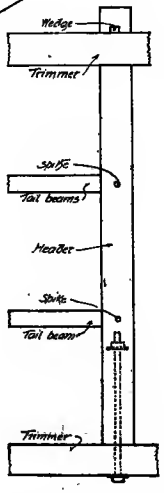


Isometric view of the floor framing about any opening such as the chimney in plate 9. The header should be fastened to the trimmer by a joint bolt, spike or wooden wedge.



Flitch Plate Girder

required by New York Building Laws for all headers 15'-0" or over in span.



Joint Bolt.

A hole is cut in the side of the joist to receive the nut and the bolt is turned into it by its head.

Scale. 3/8 full size.

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PLATE 35.

ANCHORS, CAPS, HANGERS, ETC.,

characteristic of 'slow burning' construction. They are specified on pages 11-3 of the structural iron specification.

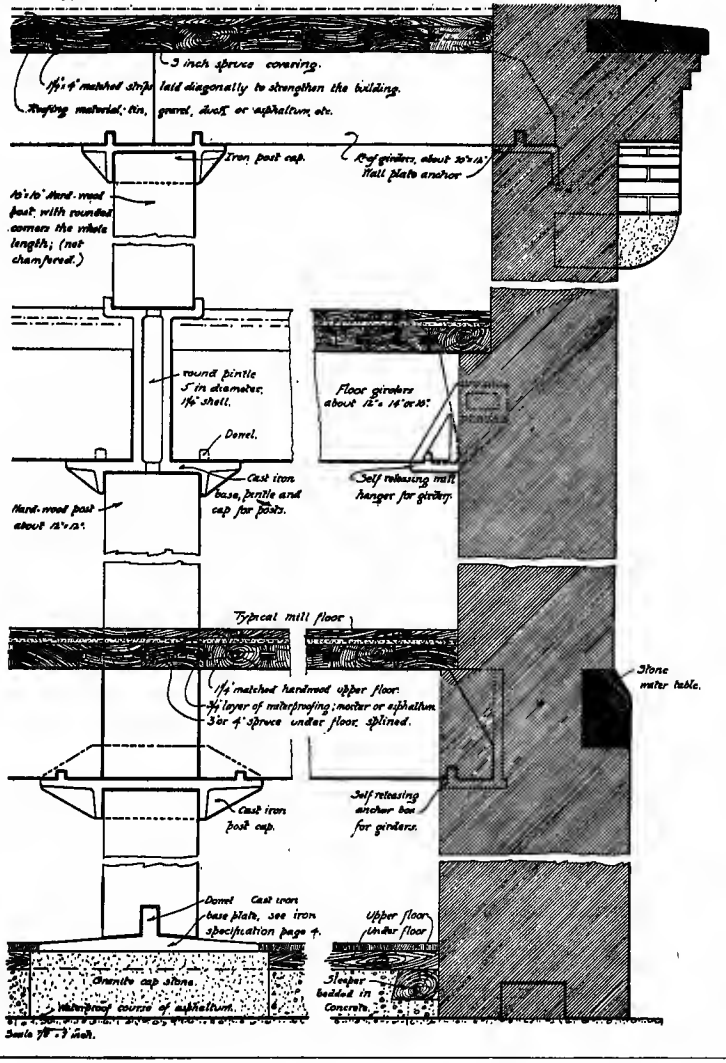

PLATE 11 M.

FOUNDATIONS.

BRICK WALLS AND CONCRETE FOOTINGS.